The Development of *Kerguelenella stewartiana* (Powell) (Gastropoda: Siphonariidae)[1]

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A species of siphonarid, *Kerguelenella stewartiana*, was described from Stewart Island by Powell in 1939. During December, 1950—January, 1951, I spent several weeks investigating the intertidal ecology of the rocky shores of Stewart Island in the vicinity of Half Moon Bay. *Kerguelenella* was found in two localities, Akers Point and Ringa Ringa. Powell records the species from Akers Point (the type locality) as, "common on seaweed-covered rocks towards high water" and from Mason Bay on the west coast of the Island, from, "low water under stones."

A striking feature of the distribution of *Kerguelenella* was that it was found only in the form of isolated colonies with a restricted horizontal range. Intensive search over about ten miles of coastline from Horseshoe Bay to the upper end of Paterson Inlet failed to reveal any further colonies. The vertical distribution of the species is also interesting. Both colonies were on more or less exposed rocks facing southeast. The Akers Point colony was found on the vertical seaward faces of large broken rocks, and the Ringa Ringa colony on the seaward side of a large isolated rock mass rising from a broken platform at about mid-tide level. All the specimens found lay in a zone extending 4 feet upward from the upper foot of the zone occupied by the red seaweed, *Bostrychia arbuscula*. This species is a conspicuous feature of the intertidal zonation of the Stewart Island region, forming a well marked band up to 3 feet in vertical extent, the upper limit lying in the vicinity of extreme high water spring tides. The vertical distribution of *Kerguelenella* thus lies above mean high water spring tides and no specimens were found below this level.

Hubendick (1946) records *Kerguelenella stewartiana* from Port Ross, Auckland Islands, "under stones at low tide level." Powell (1939), however, regarded the Stewart Island species as endemic. Judging from the observed habitat of *Kerguelenella* at Stewart Island the record of the species from "under stones at low water" is erroneous. R. K. Dell in correspondence states that he has never seen a specimen of *Kerguelenella* under stones at the Bounty Islands, Antipodes Islands, or Stewart Island, and that they are always found on rock faces near high tide.

On January 16 several small ovoid egg masses were found near the upper limit of the *Bostrychia arbuscula* zone of the Ringa Ringa colony of *Kerguelenella*. They were fastened singly or in groups of two to four to the sides of small crevices. Several were removed and subsequent examination under a dissecting microscope showed that some contained a number of limpet-like larvae in an advanced stage of development, with brown shells resembling small specimens of *Kerguelenella*

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which were taken from the adjacent rock surface. Some of the egg masses were preserved in formalin and Bouin's fluid, three were placed in a glass tube which was plugged with damp cotton wool. Ten days later at Christchurch when the tube was opened several larvae had hatched. The contents of the tube were transferred to a finger bowl of sea water and the larvae remained alive for 9 weeks, during which time about 20 hatched. Many of the newly hatched larvae were found just above the water line on the side of the finger bowl.

DEVELOPMENT

The egg masses are roughly circular or oval, about 12 mm. in diameter and 6 mm. in height. (Fig. 1*a*, *b*). Each rather tough, gelatinous, transparent egg mass contains from 9 to 35 ovoid egg cocoons, filled with a yellowish albumen. The cocoon wall is tough and in many cases the fixative penetrated poorly. After staining with Gower's aceticalum carmine and clearing it was found that some of the cocoons contained early larvae, the earliest stage present being an advanced veliger 0.14 mm. long, in an egg capsule 2 mm. in its greatest diameter (Fig. 1*d*). Because of the poor fixation details of the structure of the veliger could not be seen, particularly the structure of the shell which had collapsed and crumpled in all the specimens examined. However, it was possible to see that the veliger (Fig. 1*e*) is provided with a well-developed, ciliated, bilobed velum.

The veliger stage is passed within the egg mass, the larva hatching in the crawling stage. The next stage present was a post veliger 0.60 mm. long (Fig. 1*h*). From this stage there is little change in structure apart from increase in size. When the larvae leave the egg masses they are approximately 1.5 mm. long, quite colourless except for two black eyes (Fig. 1*f*, *i*). The shell is horny, brownish, semi-transparent with well-marked growth rings (Fig. 1*g*).

The smallest individuals taken from the adjacent rock surface were 4.5 mm. long (Fig. 1*j*,*k*). A random sample of 34 individuals gave the following size distribution:

Length (mm.)	Number
4.5– 5.5	6
6.0– 7.0	0
7.5– 8.5	7
9.0–10.0	0
10.5–11.5	5
12.0–13.0	4
13.5–14.5	8
15.0–16.0	4

The largest individual found in the colony was 15.5 mm. long.

DISCUSSION

Hubendick (1946) lists some 60 species belonging to the Siphonariidae. He recognizes 2 genera, *Williamia*, with 4 species, and *Siphonaria*, with 59 valid species. On the basis of comparative anatomy he divides the Genus *Siphonaria* into 10 natural groups, namely, *Liriola*, *Pachysiphonaria*, *Benhamina*, *Kerguelenia*, *Patellopsis*, *Simphisiphonaria*, *Ductosiphonaria*, *Heterosiphonaria*, *Sacculosiphonaria*, and *Siphonaria*. Other workers consider some of these as genera.

There appears to be confusion concerning the status of some of the New Zealand species of Siphonariidae. Powell (1946), following Suter (1913–15) recognized three genera and five species for New Zealand, *Siphonaria australis* Quoy and Gaimard, *Siphonaria cookiana* Suter, *Siphonaria zelandica* Quoy and Gaimard, *Benhamina obliquata* (Sowerby), and *Kerguelenella stewartiana* (Powell). Hubendick, however, did not recognize *S. zelandica* as a separate species considering it to be a synonym of *S. australis*. An examination of shell characters and genitalia of specimens from many localities has shown that there are three species of *Siphonaria* in New Zealand. *S. zelandica* appears to be a distinct and valid species and, as Powell (1946) noted, the specimens assigned by Hubendick to *S.* (*Simphisiphonaria*) *cookiana* belong to *S. zelandica*, since the gen-

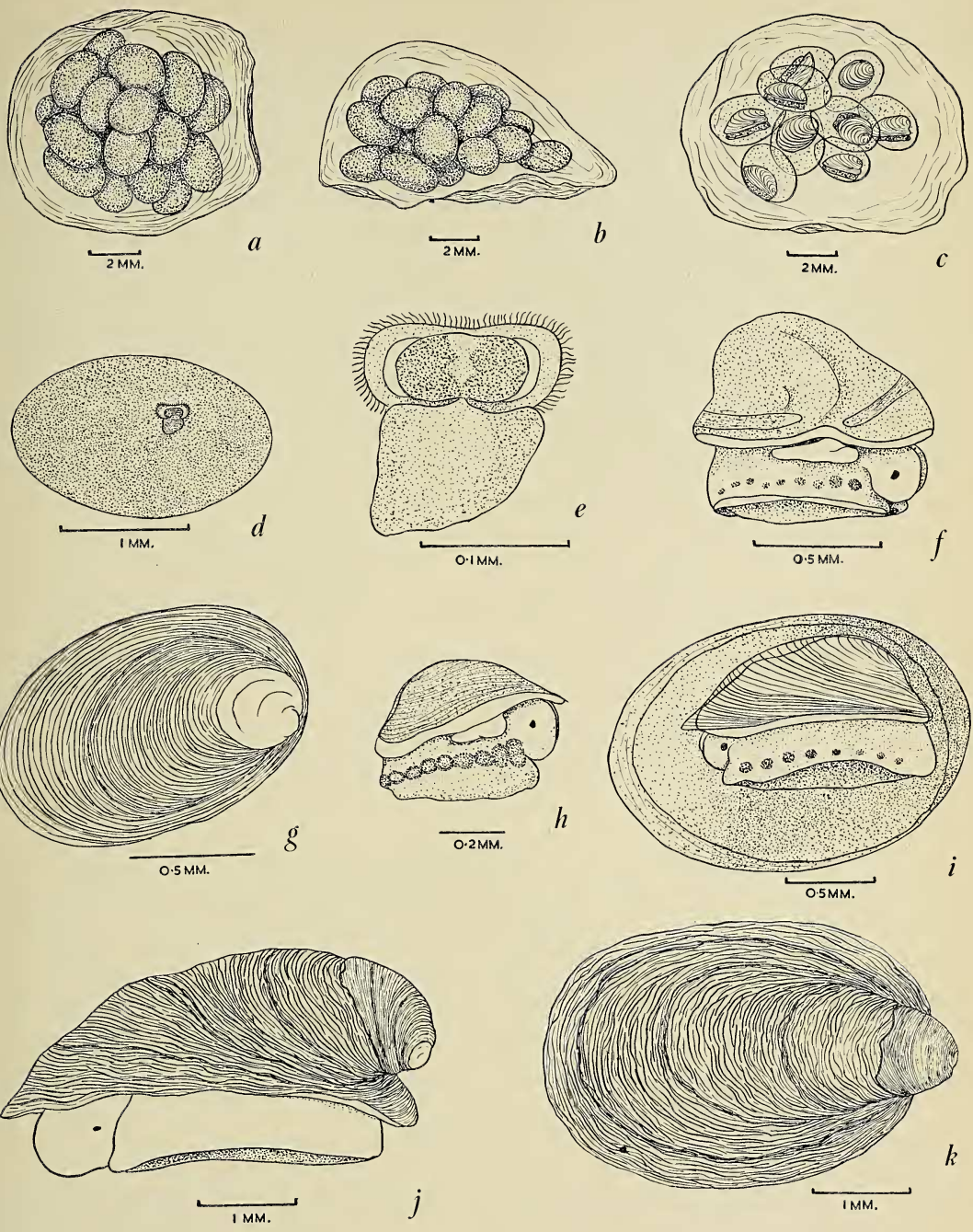

FIG. 1. Stages in the development of *Kerguelenella stewartiana* Powell. *a*, Egg mass from above; *b*, egg mass from the side; *c*, egg mass with fully developed larvae; *d*, egg cocoon with fully developed veliger (from stained material); *e*, veliger (from stained material); *f*, fully developed larva with the shell removed; *g*, larval shell; *h*, smallest post-veliger found in the egg cocoon; *i*, fully developed larva ready to emerge (part of the wall of the egg cocoon has been cut away); *j*, smallest individual taken from the rock surface; *k*, shell of the same individual.

italia he figures (Fig. 12, p. 14) are those of the latter species. The genitalia of the true *S. cookiana* are quite distinctive.

A search through the literature shows that the development of only six species of Siphonariidae is known. These are: *S. (Simphisiphonaria) zelandica* Quoy and Gaimard from New Zealand, described by Hutton (1882) as *S. australis* Quoy and Gaimard; *S. (Patellopsis) pectinata* (L.) from the Southern Mediterranean, described by Dieuzeide (1935) as *S. algesirae* Quoy and Gaimard; *S. (Sacculisiphonaria) japonica* (Donovan) from Japan, described by Abe (1939) as *S. atra* Quoy and Gaimard; ? *S. (Sacculosiphonaria) cochleariformis* Reeve from Japan, described by Fujita (1904) as *S. lepida* Gould; *S. (Patellopsis) belcheri* Hanley from the Persian Gulf, described by Thorson (1940) as *S. sipho; S. (Siphonaria) kurracheensis* Reeve also described by Thorson (1940) from the Persian Gulf. Of these the last species has a non-pelagic development, the others a pelagic larval stage. In addition observations by Borland (1949) on *Benhamina obliquata* and by myself on *S. cookiana* and *S. australis* indicate that these three species also have a pelagic larval stage. The development of representatives of only four of the ten groups into which Hubendick divides the Genus *Siphonaria* is known, and to date the development of the *Kerguelenella* group, which consists of four species having a circumantarctic distribution has remained unknown.

Among the species of Siphonariidae for which the development is known *K. stewartiana* is notable for the size of the egg and the small number of eggs in the egg mass. Table shows a comparison of the eggs of K. stewartiana and three other species.

S. (Siphonaria) kurracheensis, the other species with direct development, also occurs at or above the high water level. The species with a pelagic larval stage all occur below high water in the intertidal zone proper.

In *S. (Patellopsis) pectinata* (Dieuzeide, 1935) and *S. (Simphisiphonaria) zelandica* (Hutton, 1882) the larval shell appears to be lost and does not form part of the adult shell. In *K. stewartiana* as in *S. kurracheensis* (Thorson, 1940) and *Williamia vernalis* (Hubendick, 1946) the larval shell forms the upper part of the adult shell (Fig. 1*l*,*k*).

TABLE 1
SIZE OF EGG MASS, NUMBER OF EGGS, AND SIZE OF EGG OF SEVERAL SPECIES OF SIPHONARIIDAE

SPECIES	SIZE OF EGG MASS	NUMBER OF EGGS PER MASS	SIZE OF EGG
K. stewartiana	12 mm.	12–25	2.00/1.35 mm.
S. kurracheensis	12 mm.	Hundreds	0.50/0.38 mm.
S. belcheri	25 mm.	Numerous	0.25/0.17 mm.
B. obliquata	25–50 mm.	45,000–190,000	Unknown

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